

PASS

Plug and Switch System
PASS M00, PASS M0, PASS M0S



ABB

Focus factory

The ABB Focus Factory based in Lodi, Italy is one of the facilities belonging to ABB Group, it deals with High Voltage electrical equipments with a built-up area of over 12,000 square meters.

It is a Global Focus Factory, a centre of excellence when it comes to designing and manufacturing high voltage hybrid-breakers and switchgears, a market leader. It exports approximately 80% of its products worldwide.

The factory is organized according to "Lean Production" criteria and is managed by means of an integrated ERP system. The Quality System conforms to ISO 9001 standards, the Environmental Management System to ISO 14001 standards, and the Health and Safety Management System to OHSAS 18001 standards.

Both quality and environmental management systems are certified by DNV (SINCERT accredited).



Laboratories

ABB plant has internal laboratories equipped with state-of-the-art equipment in order to carry out material experimental, climatic, mechanical life, electromagnetic compatibility, commissioning and dielectric tests. Type and routine tests ascertain whether the components, construction stages and finished products comply with the strict specification requirements. The Test Laboratory is accredited by an external independent organization and complies with UNI CEI EN ISO/IEC 17025 Standards.



Production

Thanks to the new shop-floor layout, designed according to the Just in Time, Lean Manufacturing and Theory Of Constraints techniques, the production workflow is managed on an “Assemble to Order” basis, i.e. each module is fully assembled and manufactured once the order has been received. The output of each production line is a completely assembled and tested product, ready for an easy and fast erection and commissioning.

Service

Thanks to its Service structure, ABB plant provides all the backup to customers after sales needs: analysis and modification of existing installations, diagnosis of modules conditions, solution for life cycle cost reductions, upgrading to achieve compliance with Standards and laws, retrofitting and revamping interventions, training and updating of maintenance personnel, as well as emergency interventions.



Introduction

The Hybrid Switchgears

The arrival of the newly created PASS M0S switchgear for voltages up to 245 kV, has enlarged the PASS family, ABB's hybrid "Plug And Switch System" solution. Starting with voltages of up to 100 kV with PASS M00, then through to PASS M0, which can be used for voltages up to 170 kV and the above mentioned PASS M0S used for voltage values up to 245 kV, almost all the transmission and distribution voltage levels can be served by PASS modules.

The term "Hybrid" refers to the combination of both conventional air insulated switchgear (AIS) and the newer SF6 metal-clad insulated switchgear (GIS), which takes advantage of the two different technologies. The Hybrid switchgear solution uses already existing, tried-and-tested gas insulated switching components but also a conventional and very reliable AIS bus to connect the various hybrid modules.

All the functions (except the ring type current transformers) are sealed in a single SF6 gas insulated housing:

- Circuit Breaker
- Disconnectors
- Earth switches
- Cable sealing ends
- Fast earthing switches
- SF6 VTs or voltage sensor
- Control and protection cabinet.

PASS could also be called "Performance And Save Space" as any substation layout can be obtained by making efficient use of the available space.

Advantages

PASS combines all the typical functions of a complete AIS bay for electrical substations with voltage ratings of up to 245 kV in a unit whose volume is comparable to that of a conventional circuit-breaker of equal class.

It takes advantage and widens the scope of the operating philosophy of the PASS series whose dominating factors, those that have dictated the product's success with more than 2000 systems sold throughout the world, are briefly outlined below:

1. Relatively inexpensive AIS bus bar.
 - Yet traditionally highly reliable.
2. All live contacts in SF6.
 - Experience has shown that AIS disconnector switch contacts require relatively high levels of maintenance whereas the experience with GIS has been exactly the opposite.
 - SF6 technology means less ongoing maintenance.
 - Highly reliable equipment leading to a lower global life cycle cost.



3. Fewer switching elements.

- Use of highly reliable GIS style switches allows the switching elements to be rationalized.

4. Per-tested in Factory also for earthquake.

5. Competitive installation cost:

- time on site minimized
- less risk of delay due to adverse site conditions
- less demand for skilled resources at site.

6. High degree of factory assembly.

- Higher quality finished bay than if it was assembled under site conditions

7. Facilitates monitoring / on-line diagnostics.

- Integrated nature of the plant facilitates the introduction of electronic monitoring and on-line remote diagnostic analysis

8. Modularization of the substations:

- savings during the design and construction phases
- minimal variations using standardized components
- less risk of design errors
- higher confidence in project estimation as costs are predictable.

That means:

- very high reliability and availability of the substation
- drastic reductions in the time needed to install the equipment
- much less space required
- simplified substation layout
- less maintenance required (maintenance on demand)
- very good cost performance for purchasing, maintenance, operation, outage and relocation
- environmentally friendly: recycling / disposal at end of life.

Versatile operation

PASS features versatile operation that knows no rivals in the field of high voltage components.

PASS offers a series of modules for HV substations:

- single bus bar (SBB)
- double bus bar (DBB)
- double Circuit Breaker (DCB), not available on PASS M00.

PASS can also be used as a high voltage bay on a mobile truck, available for emergencies or if work must be carried out on already installed HV bays.



Components

Gas density control

Each PASS pole has a single gas compartment. Since the dielectric strength of the switchgear and the breaking capacity of the SF₆ circuit-breaker depend on the density of the SF₆ gas, a gas density relay is installed to control gas density and detect leakage.



Voltage Transformer

PASS can be equipped with a conventional GIS inductive voltage transformer. Similarly to Current Transformers, several combinations of windings for protection and measurements with different loads are available.



Combined Disconnector / Earthing Switch

PASS is equipped with combined disconnector/earthing switch. The mechanism has a minimal number of mechanical components and is intrinsically reliable, and maintenance free.

All combinations are possible. In all PASS versions, the position of the combined disconnector/earthing switch is clearly shown by an indicator, which is mechanically coupled to the shaft. In addition to this, visual confirmation can be obtained by means of a view port in the enclosure. The disconnector/earthing switch may, in an emergency, be operated manually by means of a crank.



Over-pressure relief

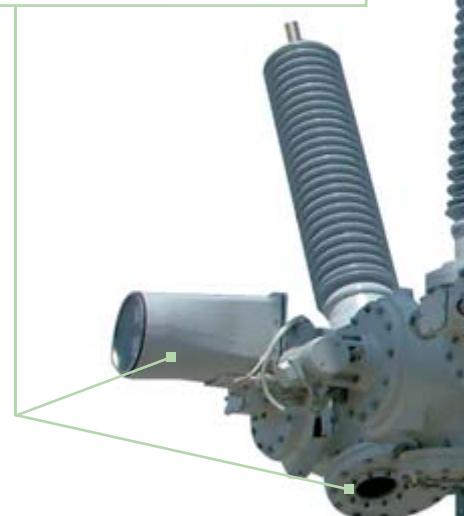
A rupture diaphragm (rupture disk) is installed to protect against excessive over-pressure due to internal arc faults. When a predetermined overpressure is reached, the rupture disk will break and relieve the pressure which would otherwise cause the enclosure itself to break. Deflectors in front of the diaphragms ensure the safety of personnel.

SF₆ Gas Insulated System

The compact design of the PASS module is due to the excellent insulation qualities of SF₆ gas. Its dielectric strength in a homogeneous field is about 2.5 times greater than that of air at the same temperature and pressure. The design of the live components is such that the field distribution is as homogeneous as possible, which allows the intrinsic strength of the insulating gas to be utilized more efficiently.

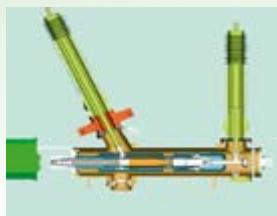
Transport

No special arrangements are needed for shipping and transportation. PASS fits into a standard truck container and does not require any packaging. Once on site, a simple 30° rotation of the outer poles is required for the final layout of PASS. The following pictures show PASS 245 kV in the DCB configuration in the transport position. The compactness is self-evident.



Circuit-breaker

The PASS circuit-breaker is a single pressure interrupter that operates by means of the well-known selfblast principle. The energy for interrupting currents is partly supplied by the arc itself, thereby reducing the energy the operating mechanism must provide by about 50% as compared to a conventional



al puffer-type circuit-breaker.

Current Transformer

PASS is equipped with a conventional current transformer, to meet the customers' requirements, e.g. for retrofitting. Several combinations of cores for protection and measurements with different loads are available.



Up to 5 cores can be fitted into the current transformer.

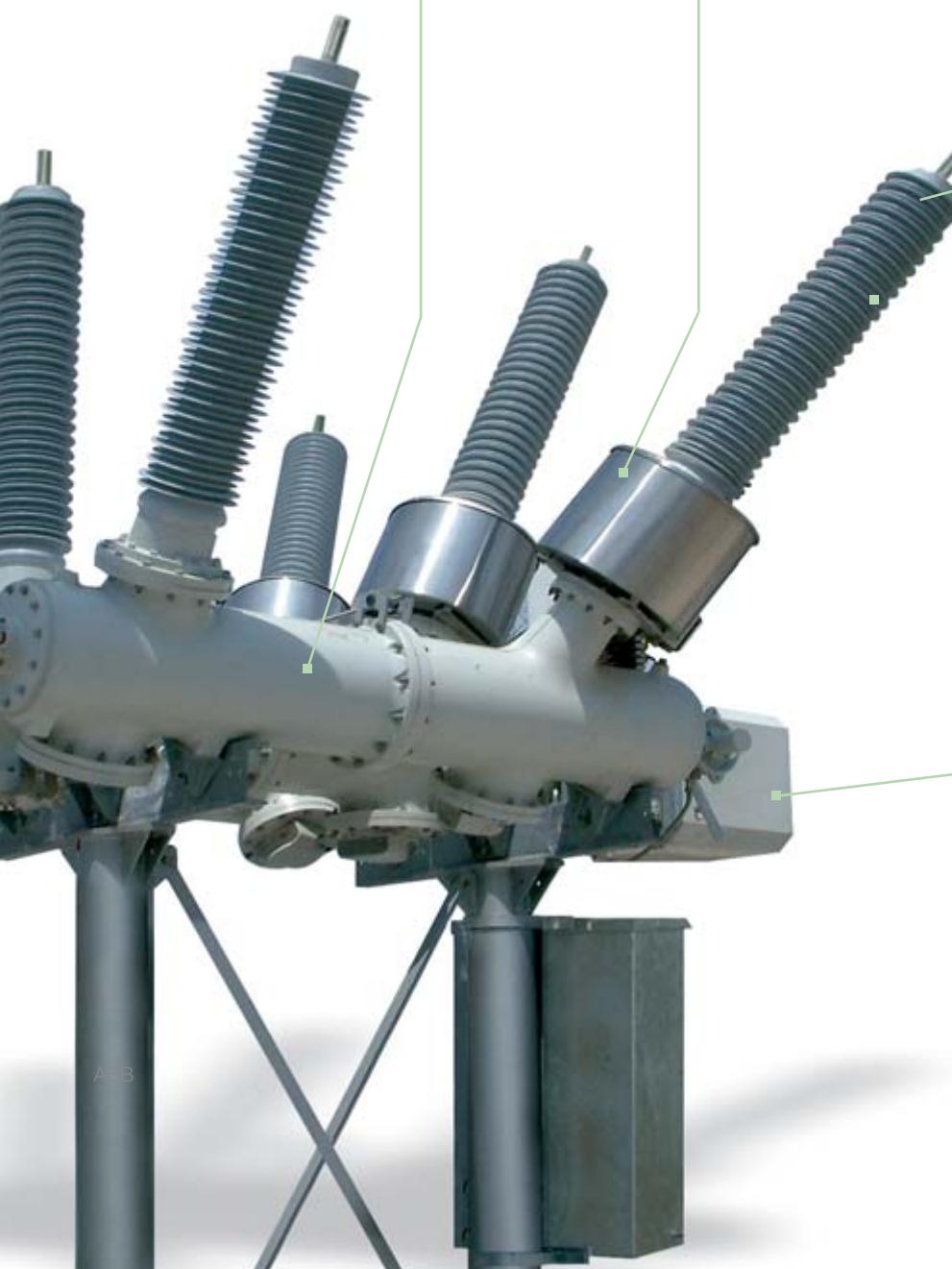
Bushings

The insulator consists of an epoxy impregnated fiberglass tube with silicon rubber sheds.



The main features are:

- high degree of safety (crack and explosion resistant)
- low weight
- excellent pollution and rain performance
- sandstorm resistant
- maintenance free.



CB drive

BLK is the spring operated drive for the circuit-breaker, designed with a minimum number of components.

BLK is available with 2 alternatives:

- BLK 82 intended for a single pole operation in line-bays where single phases auto-reclosing is foreseen^(*)
- BLK 222 intended for three pole operation^(**).

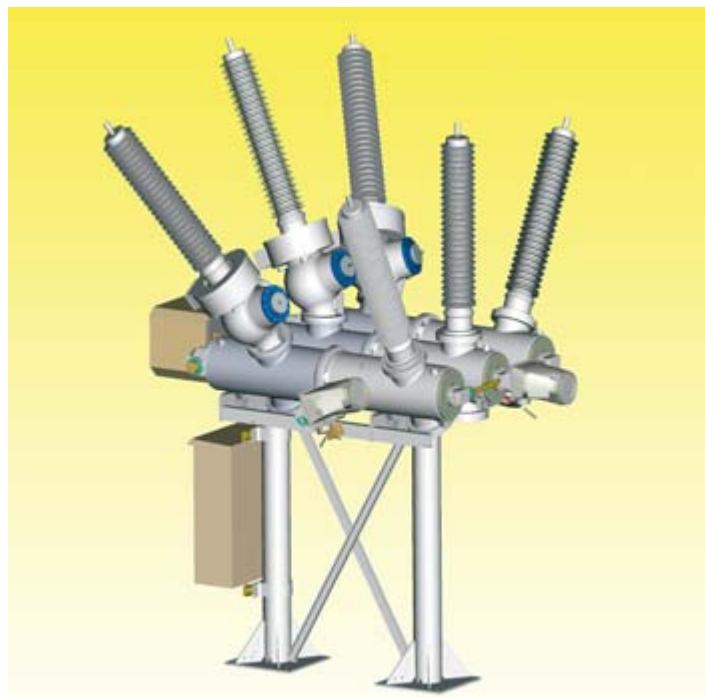


(*) For PASS M00 version the BLK82 can operate as for three pole mechanism.

(**) For PASS M0S BLK222 can operate as a single pole mechanism.

PASS M0

PASS M0 is the best seller of the family: PASS M0 was the first PASS designed (1999) and, thanks to its features (compact design, modularity and reliability), it was immediately accepted by the electrical market. Since then, more and more customers have decided to include PASS M0 in their Distribution Substation designs: the result is a reference list of more than 2,000 equivalent bays energized around the world and in very different climatic conditions. PASS M0 has, in fact, been installed both in the desert (Arabia) and in the Arctic (Russia), indoors and outdoors, on the roof of buildings (Poland) and underground.



PASS M0 is extremely flexible and meets very different final customer requirements. It may therefore have the following configurations:

- Single Bus Bar (SBB)
- Double Bus Bar (DBB)
- In and Out Substation (IOS)
- Double Circuit Breaker (DCB)



Single Bus Bar, Australia



Double circuit-breaker, Italy



Double Bus Bar, Norway



In and Out substation, Italy

PASS M00

ABB Adda designed PASS M00 in 2003 in order to meet the specific requirements of the fast-expanding market for 66 kV and 100 kV systems. This model is not just a "small brother" of PASS M0. PASS M00 is smaller in size and weight than PASS M0, but it is also a completely new module that boasts a great many innovative International Patents: the most important one is the "Rotating

breaking chamber" where the mobile contacts of the disconnector and earthing switches are directly installed on the enclosure of the circuit breaker, which opens and closes the disconnector and earthing switches by turning. All functions of a complete bay are included in one compact module. Thanks to its small size and low weight (comparable to a conventional



“stand alone” circuit breaker) PASS M00 needs only one steel supporting tube. Therefore its installation is easy in both existing or new substations. Similarly to PASS M0, PASS M00 can also have different configurations:

- Single Bus Bar
- Double Bus Bar.



Single Bus Bar, Denmark



Single Bus Bar, Italy

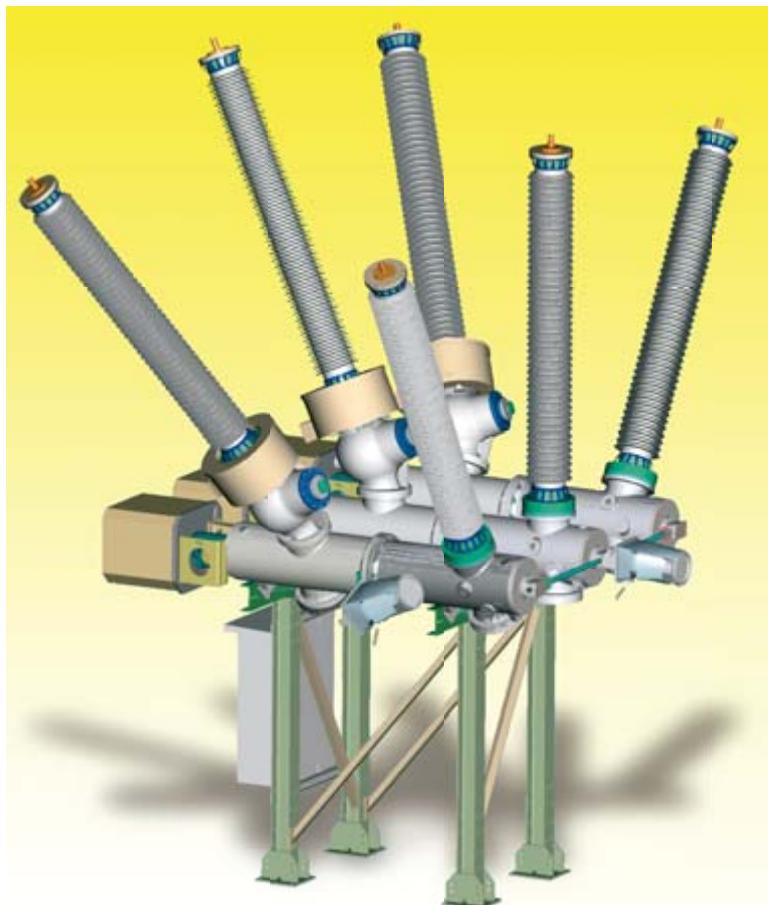
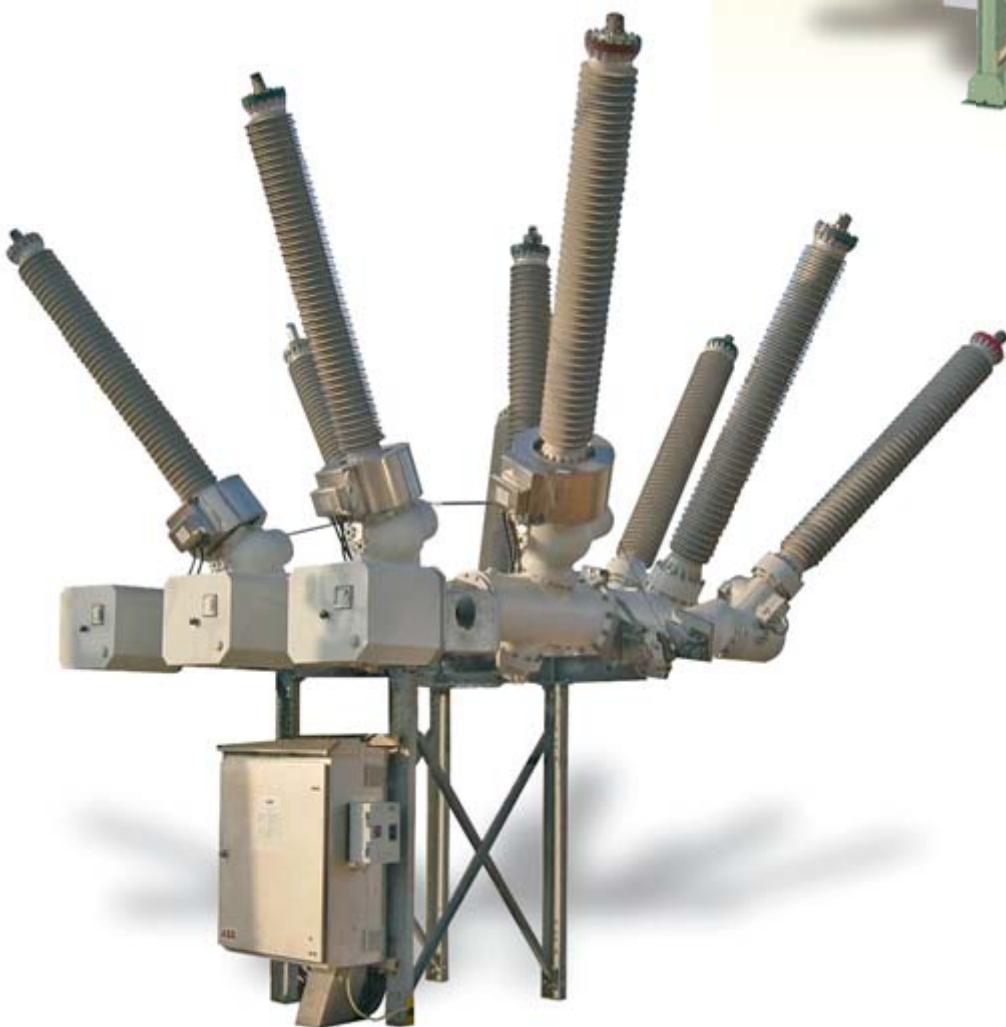
Single Bus Bar, France



PASS MOS

The PASS MOS is the latest arrival in the family and has been designed with all the PASS features in order to meet the 245 kV market requirements.

PASS MOS is the only 245 kV module to be fully designed, assembled and tested in the workshop. In addition, PASS MOS can be transported completely assembled to the site. This means that no HV test need to be conducted on site after erection and commissioning, thus saving a lot of time and money compared to all the other 245 modules (GIS, AIS or hybrid).



As usual, PASS M0S, is extremely flexible and is available in the following configurations:

- Single Bus Bar (SBB)
- Double Bus Bar (DBB)
- In and Out Substation (IOS)
- Double Circuit Breaker (DCB).



MOS, Italy



MOS, Italy

The Adda plant is ABB's leading center for Mobile Substations, thus ABB Adda is able to provide a complete solution for all customer requirements.

ABB provides all the necessary functions in a mobile substation that supplies energy in strategic areas where it is difficult to built standard substations or when it is necessary to cover peak season energy demands.

Thanks to extensive experience and know-how, ABB can provide a turn-key service that includes design and engineering of the MOSS, assembly, on-site testing and after-sales service.

For example, ABB can include the following equipment in one mobile substation:

- Power transformer
- PASS
- Voltage transformers
- Surge arresters
- Neutral earthing switches
- Auxiliary transformer
- MV switchgear (GIS)
- Control and Protection with auxiliary supply unit.



PASS Technical Data

				
		PASS M00	PASS M0	PASS M0S
Rated Voltage	kV	72.5 100	123 145 170	245
Rated Current	A	2000 ⁽¹⁾	3150	3150
Breaking Current	kA	31.5 20	40	40
AC Test Voltage	kV	140 185	230 275 325	395/460
Impulse Test Voltage – BIL	kV	325 450	550 650 750	950/1050
Altitude Above Sea	m	≤ 1000	≤ 1000	≤ 1000
Max air Temperature	°C	+ 40 ⁽²⁾	+ 40 ⁽²⁾	+ 40 ⁽²⁾
Min air Temperature	°C	- 30 ⁽²⁾	- 30 ⁽²⁾	- 25 ⁽²⁾
Relative humidity	%	100	100	100
Wind pressure	Pa	700	700	700
Sun radiation	W/m ²	≤ 1000	≤ 1000	≤ 1000
Earthquake (IEC 1166)	g	0.5	0.5	0.5
Protection deg. (IEC 60529)	IP	44 ⁽³⁾	44 ⁽³⁾	44 ⁽³⁾
Pollution Level (IEC 60815)		III Heavy ⁽⁴⁾	IV Very Heavy	IV Very Heavy

(1) 2500 A up on request.

(2) Different temperatures on request.

(3) Different degree on request.

(4) Level IV (very heavy) on request.

Environmental impact

PASS is environmentally friendly. It has been designed in compliance with the philosophy of the PASS project, which combines functional and reliable systems with use of highly recyclable, non-energy consuming materials with a low impact on environment. When materials with different characteristics have to be used, the greatest care is taken in order to obtain good performance while limiting the impact on the environment as compared to that exercised by similar conventional components.

The fact that several functions are integrated determine an equally evident, drastic and global reduction in the impact on the environment. This is because all the materials used for the typical conventional bay (such as the steel for supports, the porcelain of the insulators, the concrete of the foundations, the copper of the conductors and the aluminium used to connect the components together, etc.) have been completely eliminated.

Global life cycle cost and impact on the environment were considered right from the very beginning, when PASS was designed. Compared to a conventional air insulated solution which implements the same functions, PASS meets the following targets:

- SF6 reduced by 80%
- maintenance cost reduced by 38%
- space reduced by 70%
- total life cycle cost less than 60%.

Compared to a conventional 5 bays H layout air insulated substation, the global life cycle cost for PASS is estimated to be more than 30% lower. Moreover, PASS M0 has been subjected to the LCA (Life Cycle Assessment), a study that covers all environmental aspects during the whole life of the product. In relation to this, the EDP (Environmental Product Declaration) provides a quantitative and assessed description of the environmental performance of PASS, viewed from a comprehensive life cycle perspective.





Life Cycle Cost

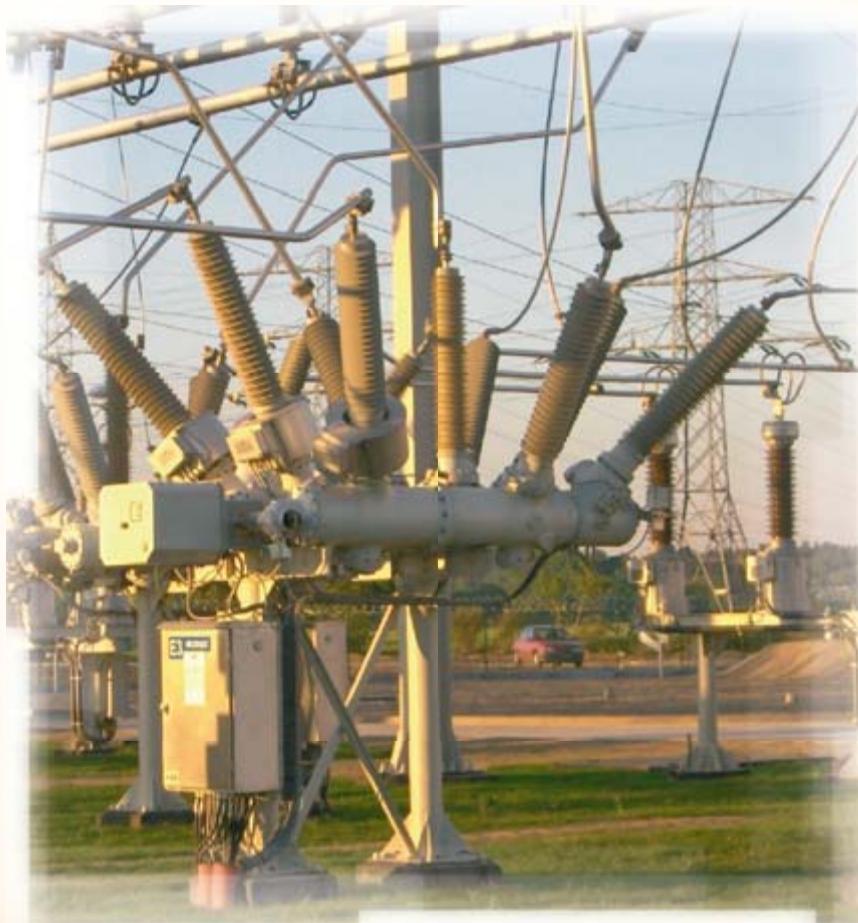
The CEI 56-13 Standards that relate to Standard IEC300-3 act as guidelines when calculating the Life Cycle Cost (LCC) of a product.

Since 1999, ABB has also been using a calculation method that allows to evaluate the cost of the entire life cycle of an installation (initial cost of the investment, fixed charges for management and preventive maintenance, variable costs due to corrective maintenance following faults).

People who must compare performance and relative costs throughout the entire life cycle of the actual product, and not the mere technical aspects can better understand the philosophy of PASS: products are no longer considered as a technological end to themselves, but become part

of the operating context of a process, to whose profitability they are strongly linked.

As an example, let's take a conventional bay installed in an HV/MV substation in an operating cement works: the cost for lack of production when the system is out of service would be about 3 times higher than the cost of installing PASS. Similarly, PASS is more reliable since it is less liable to become faulty. Moreover, it needs servicing less frequently throughout the life of the installation, and maintenance work can be carried out much faster. If these features are considered in relation to the process on the load side of the installation, it will be evident that PASS is able to achieve remarkably interesting financial savings.



New features

Motor drive

A motor drive is a digitally controlled motor that directly moves the circuit breaker contacts. ABB has developed a servomotor system with digital control, able to directly drive the circuit breaker contacts in a highly accurate and reliable way. The number of moving parts in the drive is reduced to just one, i.e. the rotating motor shaft.

Main functions description

The working of motor drive is summarized in few simple operations: the rotor is directly connected to the drive shaft of the circuit breaker. The integrated resolver in the motor continuously monitors the rotor position.

This information is fed directly back to the Control Unit. The Control Unit verifies the measured position, compares it to the position required at that instant by the pre-programmed travel curve.

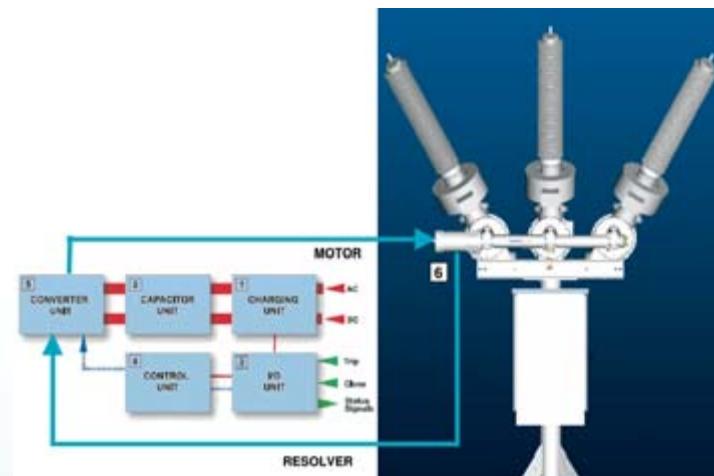
It sends further control signals to the Converter Unit to continue the motion of the circuit breaker. Thus the circuit breaker contacts are precisely controlled during their entire motion by comparing the feedback data with the preprogrammed travel curve stored in the Control Unit memory.

Extensive type test

The motor drive is type tested in accordance with IEC and ANSI standards. Of particular interest, in view of the largely electronic nature of the motor drive, are the EMC tests conducted in accordance with IEC and EN standards.

Simple erection

Installation and commissioning are easy. Each motor drive is pre-tested and shipped to the installation site in the form of a few pre-assembled units.



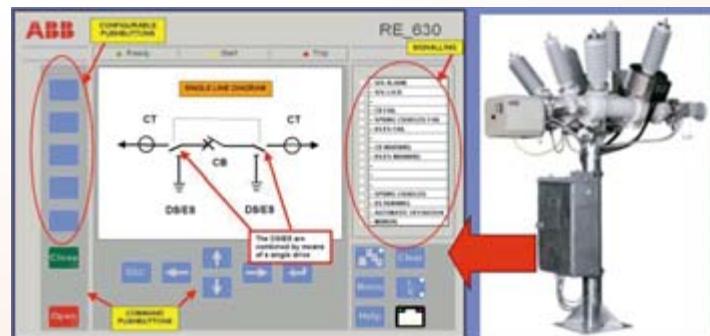
Protection and control

Integration of protection relay inside the control cubicle

The idea is to integrate station monitoring with the circuit breaker and disconnector control function into one commercial high performance protection and control IED. Voltage and current signals used by the protection unit are also supplied to the control system without the need of any additional wiring.

Integration of most of the required functions into one compact unit is considered a key factor for improving cost performance, cubicle/station layout, etc.

Communication (or links) with a remote PC (for supervision and configuration) or with a remote operator control room is based on IEC 61850 standards.



UniWire

The UniWire cubicle is designed to replace the traditional wired logic using electromechanical components with a programmable logic controller, while maintaining the same CB operating mechanism, DS drive, etc...

The wiring diagrams are simple, the cubicle tidy and mainly formed by standardized parts, with a lot of space for the wiring duct, terminal blocks, customer's equipment.

In addition, station monitoring with the circuit

breaker and disconnector control functions can be integrated into one commercial high performance protection and control IED.

The local panel interface is large with robust push buttons and high bright signalling for full control and status check. Each part (command, single line diagram and indication) is configurable to provide high flexibility and capability.

Installation and commissioning are easy, the cubicle is delivered already configured, tested and ready to be operative.



Quality

A comprehensive environmental, quality, health and safety system testifies to our commitment towards reducing the impact produced by our processes on the environment and improving the health and safety of our employees.

Our Quality Management System has been certified according to ISO 9001 since 1992, while our Environmental Management System has been certified according to ISO 14001 since 1998.

Through the Environment Product Declarations (EPD) and friendly Environmental Performance Declaration, ABB Adda provides the necessary information about the environmental performance of the products during their whole Life Cycle, in compliance with the Standard Requirements ("Specific Product Requirements").

The target of our High Voltage Products division is to be the Quality Leader in our industry and to be clearly perceived as such by Customers. To achieve this goal, we give Quality aspects a priority, especially at operational level. All the internal and external functional areas are involved in maintaining and improving the global quality, across all the processes.



A sample test plan ensures that the incoming materials have been regularly inspected.

On the other hand, materials, parts or components from new suppliers or from a critical supplier are automatically flagged for 100% inspection.

Special destructive and non-destructive tests are conducted in our laboratories. Here, we check for compliance with the technical specifications or with prototypes through tests such as overpressure, corrosion, hardness, etc.

All instruments and equipment used for testing are systematically and periodically calibrated by our metrological laboratory.

Standard operation procedures are essential to ensure a correct assembly process.

The documents provide step-by-step assembly instructions for each part we manufacture.

All assembly and test checklists are collected and stored in a file to ensure that the products and single sub-materials are fully traceable.

The final tests prove that the product conforms to the customer's specifications and to the applicable International Standards (e.g. IEC).

- IEC 62271-203 - SF₆-Switchgear
- IEC 60694 - High Voltage Switchgear
- IEC 62271-100 - circuit breakers
- IEC 62271-102 - disconnector/earthing switch
- IEC 60044-1 - current transformers
- IEC 60137 - bushing
- IEC 61462 - insulator.

The test results and the Declaration of Conformity to customer specifications and to the applicable international standards are included in the test report.

The completeness of the supply is verified in the final inspection, performed on each product.



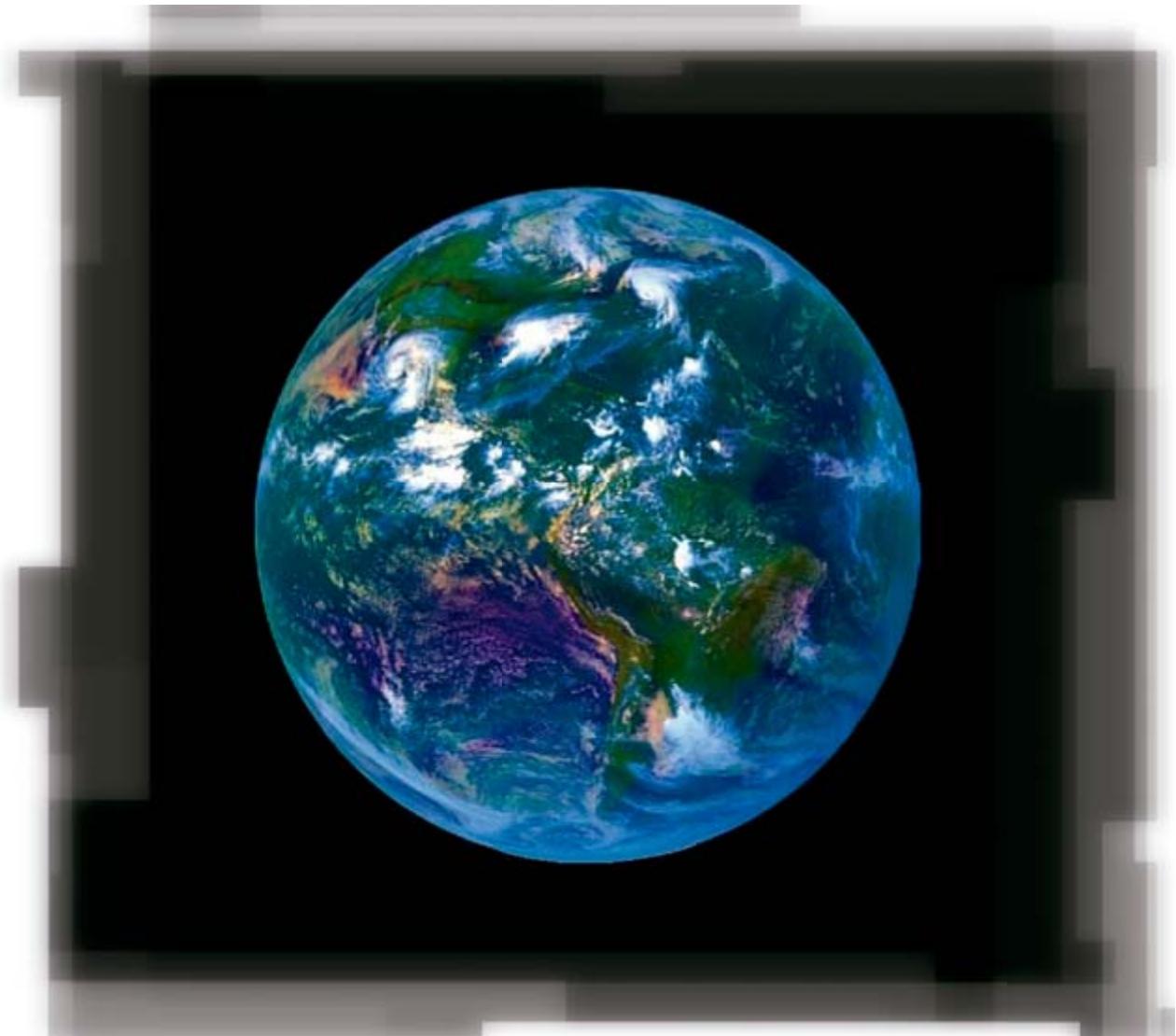




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